Positions and areas of sun spots—Continued

Date	Eastern standard civil time	Heliographic		Area	
		Longitude	Latitude	Spot	Group
1927—Continued	h. m.	°	°		
July 17 (Mount Wilson)	9 40	−47.0	−30.0		12
		−19.0	−12.0		237
		+14.0	+15.0		26
		+63.0	−12.0		20
July 18 (Naval Observatory)	11 42	−6.0	−12.5		185
		+27.0	+14.5		31
July 19 (Mount Wilson)	12 8	−78.0	+23.5	98	
		−39.5	−10.0		7
		+9.5	−11.0		170
July 20 (Naval Observatory)	11 42	−63.5	+23.0	93	
		+20.5	−11.5	93	
		+25.0	−15.5	15	
July 21 (Naval Observatory)	11 41	−80.0	−9.0	309	
		−50.0	+23.0	123	
		−11.0	−9.5		62
		+36.0	−14.5		93
July 22 (Yerkes)	18 0	−35.0	−8.0	25	
		−65.0	+24.5	75	
July 23 (Naval Observatory)	11 43	−55.0	−9.0		370
		−24.5	+23.0	123	
		+17.0	−9.5		93
		+24.0	+10.0		15
		+64.0	−15.0		185
July 24 (Naval Observatory)	11 44	−42.5	−8.5		340
		−11.0	+23.0	108	
		+29.5	−9.5		46
		+39.0	+9.0		93
		+75.0	−19.0	12	

Positions and areas of sun spots—Continued

Date	Eastern standard civil time	Heliographic		Area	
		Longitude	Latitude	Spot	Group
1927—Continued	h. m.	°	°		
July 25 (Naval Observatory)	11 52	−29.0	−8.5		340
		+1.0	+23.0	108	
		+42.0	−9.0		93
		+52.0	+9.0		77
July 26 (Naval Observatory)	11 46	−17.0	−9.0		370
		−2.0	+14.0		15
		+14.0	+23.0	108	
		+55.5	−9.5		108
		+64.5	+9.0		93
July 27 (Naval Observatory)	11 50	−69.0	−8.0		77
		−2.5	−9.5	340	
		+13.0	+14.0		46
		+27.5	+23.0	77	
		+70.0	−10.0		62
July 28 (Naval Observatory)	11 49	−56.0	−8.0	31	
		+11.0	−9.5	309	
		+29.5	+13.5	15	
		+40.5	+22.5	77	
		+70.0	−17.0	9	
July 29 (Yerkes)	10 19	+42.0	−29.0	25	
		+27.0	+11.5	75	
July 30 (Yerkes)	12 16	+66.5	+3.5	10	
		+30.5	−21.5	75	
July 31 (Naval Observatory)	13 26	−15.0	−7.5	15	
		+23.0	+10.5		46
		+52.0	−9.5	340	
		+81.0	+22.5		309

AEROLOGICAL OBSERVATIONS

By W. R. STEVENS

Average free-air conditions for July, as determined by kites and given in Tables 1 and 2, show close agreement with the normal, except for subnormal temperatures observed at all levels at Ellendale and Royal Center. The airplane station at Washington shows positive temperature departures at all levels. However, only a three-year mean is available at this station. The free-air wind resultants show a slightly more than normal northerly component at Broken Arrow, Ellendale, and Royal Center, and a more southerly component at Due West and Groesbeck.

Easterly winds at high levels were observed at many stations as far north as Ithaca, where a northeast wind of 17 m. p. s. was reported at 10,000 meters on the 1st. They were frequent enough over Key West and San Juan to give an east component in the resultants at all altitudes, and at nearly all altitudes over Groesbeck.

A remarkable pilot-balloon record for the month was made at Medford, Oreg. Sixty-one observations were made, the lowest reaching 4,000 meters. Forty-three of the observations extended to 10,000 meters and 14 to 12,000 meters.

A good illustration of the effect of exchange of mass between different air layers upon the rate of ascent of a pilot balloon is given in the double-theodolite observation made at Groesbeck on the 21st. The balloon ascended with a velocity less than the standard inflation rate to an altitude of 3,600 meters, which indicated a descending current of 0.5 m. p. s. The opposite effect of convection upon the ascensional rate of pilot balloons has been very frequently observed, but descending currents are of much larger cross section than ascending currents; consequently the former have a much lower velocity than the latter, and the observations less frequently prove the existence of descending currents.

Two "free-rising" captive balloon flights were made during the month. This method is quite satisfactory for obtaining free-air observations when winds are too light for kites. Instead of the balloon pulling the wire out, as is done in kite flying, the wire is reeled out so rapidly that the balloon rises freely, except for the increasing weight of the wire. The Fergusson meteorograph is used, which is described in this REVIEW, p. 293. The ascent at Royal Center attained an altitude of 2,356 meters. A flight was also made at Due West by this method. However, just before reeling in, a kink developed when the wire came to the ground suddenly and the balloon broke away. The balloon and instrument came down undamaged about 12 miles from the station, from whence they were returned. The altitude reached was 5,437 meters.

Meteorological conditions over Due West, S. C., on July 14, 1927

Time	Altitude (m.)	Temperature	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity	Wind	
					Direction	Velocity
	m. s. l.	°C.		Per cent		m. p. s.
11:22 a. m.	217	28.2		68	WSW	4.5
11:53 a. m.	666	22.8	1.20	77	W	8.0
12:05 p. m.	1,121	21.5	0.29	66	W	8.3
12:29 p. m.	1,676	17.8	0.67	67	WNW	6.4
1:11 p. m.	2,507	12.2	0.65	67	W	8.8
1:33 p. m.	1,576	18.1	0.49	70	W	7.2
1:40 p. m.	1,001	20.9	1.10	88	W	5.0
1:44 p. m.	665	24.6	1.43	74	W	4.9
1:49 p. m.	217	31.0		60	SW	4.0

An unusual number of thunderstorms occurred during the month in the South Atlantic and East Gulf States, Due West reporting them on 22 days, with a total rainfall of 6.61 inches. Thunderstorms which occurred in the afternoon of the 14th in Georgia, South Carolina, and North Carolina are of a type which frequently occur in the Southeast. On this date pressure was high off the South Atlantic coast. The aerological chart shows that the air, to at least moderate altitudes, had come from the Gulf and was very moist. Therefore, in the absence of inversions, a relatively small increase in the surface temperature would produce

instability, since the diurnal change in temperature aloft is much less than at the surface. The flight on this date is a very good example of the gradual building up of an unstable lapse rate in humid air in a high-pressure area, eventually producing a thundershower.

Meteorological conditions over Royal Center, Ind., on July 28, 1927

Time	Altitude (m.)	Temperature	Δt / 100 m.	Relative humidity	Wind: Direction	Wind: Velocity
	m. s. l.	*° C.*		*Per cent*		*m. p. s.*
7:13 a. m.	225	25.6		69	sw.	4.9
7:15 a. m.	570	24.1	0.43	68	sw.	7.6
7:26 a. m.	934	24.3	−0.05	53	wsw.	13.4
7:31 a. m.	1,237	23.0	0.43	59	w.	13.8
7:35 a. m.	1,532	20.5	0.85	44	w.	16.2
7:41 a. m.	1,819	17.3	1.11	82	w.	14.6
7:58 a. m.	2,566	10.9	0.86	76	w.	13.2
8:26 a. m.	3,483	3.5	0.81	100	w.	14.4
9:07 a. m.	3,940	1.3	0.48	72	wnw.	10.3
9:22 a. m.	4,004	−0.3	2.50	100	wnw.	10.0
9:47 a. m.	4,069	−0.3	0.00	100	wnw.	9.5
9:50 a. m.	4,135	−0.9	0.91	100	wnw.	9.8
9:54 a. m.	4,174	−0.2	−1.40	100	wnw.	11.4
9:58 a. m.	4,093	−1.0	0.76	100	w.	11.4
10:03 a. m.	3,816	1.1	0.30	90	w.	14.9
10:12 a. m.	3,717	1.4	0.91	100	w.	15.8
10:34 a. m.	2,852	9.3	0.70	76	w.	13.8
10:46 a. m.	2,223	13.7	0.87	97	w.	14.7
11:08 a. m.	1,239	22.3	0.71	50	w.	12.0
11:18 a. m.	490	27.6	2.04	56	wsw.	6.3
11:24 a. m.	225	33.0		45	w.	5.4

A valuable kite flight to over 4,000 meters was made at Royal Center on the 28th. It was made under threatening conditions and followed by a severe thunderstorm with a rainfall of 1.62 inches. Flights under these conditions to high altitudes are quite rare. This ascent seems unquestionably to furnish an example of an overrunning cold front. This produces a type of upper air convection which probably often occurs in the United States, although examples are very scarce due to the difficulty and danger of obtaining soundings. For a very thorough discussion, see paper by Rossby and Weightman in the MONTHLY WEATHER REVIEW for December, 1926. The conditions which characterize an overrunning cold front are satisfied in this example. We find a cold front extending from Ontario southwestward to Colorado on the morning weather map for this date. A number of thunderstorms occurred during the night considerably in advance of the wind shift line. The region over which they occurred corresponds very well with the area over which the overrunning was taking place. This is very clearly indicated on the aerological maps, successive levels aloft showing the front displaced farther and farther to the east.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during July, 1927*

TEMPERATURE (°C.)

Altitude (m.) M. S. L.	Broken Arrow, Okla. (233m.) Mean	Broken Arrow, Okla. (233m.) Departure from 9-yr. mean	Due West, S. C. (217m.) Mean	Due West, S. C. (217m.) Departure from 7-yr. mean	Ellendale, N. Dak. (444m.) Mean	Ellendale, N. Dak. (444m.) Departure from 10-yr. mean	Groesbeck, Tex. (141m.) Mean	Groesbeck, Tex. (141m.) Departure from 9-yr. mean	Royal Center, Ind. (225m.) Mean	Royal Center, Ind. (225m.) Departure from 10-yr. mean	Washington-D. C.[1] (7m.) Mean	Washington-D. C.[1] (7m.) Departure from 3-yr. mean
Surface	25.4	−1.2	26.0	−1.1	18.1	−2.9	26.6	−0.2	23.5	−1.4	25.2	+1.2
250	25.3	−1.2	25.7	−1.1			25.9	0.0	23.2	−1.4	23.5	+1.2
500	24.5	−0.5	23.7	−0.7	17.8	−2.8	24.5	+0.4	20.5	−1.6	22.2	+1.2
750	23.5	−0.1	22.1	−0.5	16.7	−2.6	23.1	+0.2	19.1	−1.3	21.0	+1.1
1,000	22.2	0.0	20.6	−0.3	15.8	−2.3	22.0	+0.2	17.6	−1.1	19.5	+1.0
1,250	20.8	+0.2	19.0	−0.2	14.8	−2.2	20.7	+0.1	16.3	−0.8	18.1	+1.1
1,500	19.3	+0.2	17.6	0.0	13.8	−2.0	19.4	+0.1	14.8	−0.8	16.6	+1.1
2,000	16.6	+0.6	14.6	+0.3	11.3	−1.8	16.9	+0.3	11.3	−1.4	13.6	+1.1
2,500	13.5	+0.7	11.4	+0.2	8.6	−1.6	13.8	0.0	8.4	−1.6	10.8	+1.1
3,000	10.3	+0.7	9.5	+1.2	5.7	−1.6	10.2	−0.7	5.7	−1.4	7.4	+0.4
3,500	7.4	+0.7	7.3	+2.0	2.9	−1.5	7.5	−0.4	3.3	−1.0		
4,000			5.6	+2.9	0.1	−1.6	4.9	0.0	0.4	−1.1		
4,500			3.4	+3.3	−2.3	−1.5			−2.6	−1.3		
5,000					−4.1	−0.8			−6.0	−1.3		

RELATIVE HUMIDITY (%)

Surface	75	+6	73	+8	78	+9	75	+2	62	0	69	−4
250	75	+6	73	+8			76	+2	62	0	71	−2
500	68	+2	71	+4	77	+9	78	+3	65	+1	68	−1
750	64	0	71	+2	72	+8	77	+6	65	0	66	−1
1,000	64	0	73	+2	69	+7	71	+5	67	0	67	+1
1,250	62	−2	75	+3	68	+8	68	+5	64	−3	65	−1
1,500	60	−3	74	+2	65	+7	66	+4	65	−2	66	−1
2,000	51	−9	72	0	62	+6	57	−2	68	+4	67	−1
2,500	50	−9	71	0	60	+6	55	−2	63	+6	64	−2
3,000	49	−10	73	+3	62	+10	59	+2	57	+5	63	+1
3,500	45	−13	87	+17	60	+8	58	−1	48	−1		
4,000			72	+7	58	+6	53	−8	38	−5		
4,500			80	+19	50	−2			37	−6		
5,000					47	0			37	−6		

VAPOR PRESSURE (*mb.*)

Surface	23.86	+0.05	24.28	+1.49	16.08	−0.93	25.95	+0.42	17.68	−1.69	22.23	+0.17
250	23.64	+0.01	23.87	+1.43			25.44	+0.79	17.45	−1.64	20.65	+0.62
500	20.74	+0.01	20.69	+0.74	15.59	−0.85	23.97	+1.57	15.50	−1.43	18.09	+0.59
750	18.36	−0.22	18.77	+0.38	13.69	−0.57	21.75	+2.05	14.32	−1.17	16.19	+0.44
1,000	16.85	−0.12	17.46	+0.41	12.30	−0.45	18.78	+1.64	13.49	−0.82	14.95	+0.70
1,250	15.09	−0.34	16.12	+0.42	11.45	+0.02	16.61	+1.43	11.89	−1.04	13.45	+0.43
1,500	13.14	−0.72	14.42	+0.25	10.15	−0.06	14.91	+1.22	10.76	−0.81	12.39	+0.33
2,000	9.40	−1.60	11.63	+0.10	8.29	+0.01	11.01	−0.18	8.93	+0.01	10.22	+0.26
2,500	7.51	−1.33	9.43	+0.22	6.66	−0.07	8.66	−0.53	6.75	+0.21	8.07	+0.03
3,000	6.01	−1.13	8.59	+1.12	5.56	+0.12	7.94	+0.15	4.99	−0.02	6.30	+0.12
3,500	4.71	−1.13	8.99	+2.88	4.48	−0.05	6.95	+0.33	3.47	−0.48		
4,000			6.86	+2.05	3.50	−0.26	6.51	+0.56	2.06	−0.85		
4,500			7.34	+3.24	2.43	−0.77			1.86	−0.75		
5,000					2.06	−0.52			1.72	−0.75		

[1] Naval Air Station, D. C.

TABLE 2.—*Free-air resultant winds (m. p. s.) during July, 1927*

Altitude (m.) m. s. l.	Broken Arrow, Okla. (233 meters) Mean Dir.	Mean Vel.	9-year mean Dir.	9-year mean Vel.	Due West, S. C. (217 meters) Mean Dir.	Mean Vel.	7-year mean Dir.	7-year mean Vel.	Ellendale, N. Dak. (444 meters) Mean Dir.	Mean Vel.	10-year mean Dir.	10-year mean Vel.	Groesbeck, Tex. (141 meters) Mean Dir.	Mean Vel.	9-year mean Dir.	9-year mean Vel.	Royal Center, Ind. (225 meters) Mean Dir.	Mean Vel.	10-year mean Dir.	10-year mean Vel.	Washington, D. C. (34 meters) Mean Dir.	Mean Vel.	7-year mean Dir.	7-year mean Vel.
Surface	S. 7°W.	3.0		3.0	S. 49°W.	0.9	S. 58°W.	1.0	N. 66°W.	1.2	North.	0.3	South.	2.9	S. 18°W.	3.5	N. 63°W.	1.8	S. 82°W.	1.4	N. 68°W.	0.2	N. 30°W.	0.5
250	S. 8°W.	3.2	S. 2°W.	3.1	S. 50°W.	1.3	S. 63°W.	1.1					South.	3.7	S. 19°W.	4.3	N. 68°W.	2.0	S. 78°W.	1.5	S. 80°W.	1.4	N. 59°W.	1.2
500	S. 18°W.	5.3	S. 11°W.	4.6	S. 69°W.	2.7	S. 71°W.	1.6	N. 78°W.	1.3	Calm.		S. 9°W.	5.3	S. 25°W.	6.0	S. 88°W.	3.1	S. 72°W.	3.0	N. 37°W.	3.5	N. 56°W.	2.1
750	S. 28°W.	5.3	S. 21°W.	5.0	S. 73°W.	3.2	S. 80°W.	1.9	S. 83°W.	2.4	S. 29°W.	0.8	S. 12°W.	5.8	S. 26°W.	6.2	S. 87°W.	3.4	S. 74°W.	3.8	N. 63°W.	2.9	N. 45°W.	2.5
1,000	S. 34°W.	4.7	S. 28°W.	4.8	S. 74°W.	4.0	S. 85°W.	2.3	N. 88°W.	3.1	S. 56°W.	1.4	S. 11°W.	5.3	S. 28°W.	5.8	West.	3.7	S. 81°W.	4.4	N. 44°W.	3.2	N. 44°W.	3.1
1,250	S. 36°W.	4.0	S. 32°W.	4.5	S. 83°W.	4.1	S. 86°W.	2.6	N. 76°W.	3.3	S. 68°W.	1.8	S. 12°W.	5.6	S. 28°W.	5.3	N. 76°W.	4.8	S. 84°W.	5.2				
1,500	S. 44°W.	3.3	S. 37°W.	4.3	West.	5.5	S. 88°W.	3.7	N. 74°W.	4.4	S. 79°W.	2.6	S. 16°W.	5.2	S. 27°W.	5.0	N. 82°W.	5.5	West.	6.0	N. 48°W.	4.2	N. 55°W.	3.8
2,000	S. 64°W.	2.9	S. 43°W.	3.6	S. 89°W.	7.0	N. 87°W.	5.4	N. 78°W.	6.0	N. 89°W.	4.0	S. 19°W.	4.3	S. 28°W.	4.1	N. 81°W.	7.2	West.	7.3	N. 63°W.	4.8	N. 63°W.	4.6
2,500	S. 77°W.	2.1	S. 55°W.	3.7	S. 88°W.	7.8	N. 84°W.	6.3	N. 72°W.	7.0	N. 82°W.	5.7	S. 18°W.	4.6	S. 24°W.	4.0	N. 84°W.	9.1	N. 87°W.	9.8	N. 80°W.	6.1	N. 69°W.	6.0
3,000	S. 53°W.	2.3	S. 62°W.	4.1		10.2	N. 88°W.	8.0	N. 70°W.	8.8	N. 80°W.	7.5	S. 11°W.	7.3	S. 21°W.	4.2	N. 78°W.	10.7	N. 89°W.	11.3	S. 89°W.	6.2	N. 73°W.	7.3
3,500	S. 76°W.	3.6	S. 81°W.	4.6	S. 87°W.	10.4	N. 84°W.	8.2	N. 74°W.	9.0	N. 74°W.	10.1	S. 9°W.	7.1	S. 15°W.	3.1	N. 73°W.	8.7	S. 89°W.	10.8	N. 87°W.	7.3	N. 78°W.	7.8
4,000	N. 28°W.	5.2	S. 86°W.	5.5	S. 87°W.	10.2	N. 83°W.	8.9	N. 75°W.	8.5	N. 69°W.	11.3	S. 45°E.	5.0	S. 77°W.	1.3	N. 71°W.	8.9	N. 68°W.	10.0	N. 76°W.	6.9	N. 78°W.	8.0
4,500					West.	14.0	N. 85°W.	10.2	N. 44°W.	15.2	N. 66°W.	13.4	S. 45°E.	3.0	N. 6°W.	1.7	N. 68°W.	9.0	N. 55°W.	9.2	N. 70°W.	6.8	N. 84°W.	8.4
5,000									N. 56°W.	14.3	N. 75°W.	15.4					N. 31°W.	13.8	N. 67°W.	9.6	N. 75°W.	7.0	N. 84°W.	8.5